JACC Vol 7, No 4
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CLINICAL STUDIES

Acute Thrombotic Obstruction With Disc Valve Prostheses: Diagnostic Considerations and Fibrinolytic Treatment

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Twenty-six patients presenting with 28 instances of massive acute thrombotic obstruction of a prosthetic valve (16 mitral, 12 aortic) were treated with fibrinolytic agents. In 15 cases the patient presented with acute pulmonary edema and low cardiac output, in 10 with congestive heart failure and embolism and in 3 with peripheral embolism only. The diagnosis of thrombotic obstruction was made by echocardiography or cineradiography, in patients in whom the disc was immobile or barely moving; cineangiography was necessary in only four patients. The fibrinolytic agents administered were streptokinase, 2,000,000 U for 10 hours (14 cases), urokinase, 4,500 U/kg per h for 12 hours (7 cases), or the two agents successively (7 cases). Fibrinolysis was entirely successful in 19 patients: 18 are alive and well without surgical intervention after follow-up of 6 to 64 months and 1 patient had surgical revision after fibrinolysis. In two patients, fibrinolytic treatment was apparently successful but obstruction recurred 4 and 19 months later, respectively, and the patients were again treated by fibrinolysis. In two patients complete failure of fibrinolytic treatment led to emergency surgery, and in three patients improvement was incomplete and death occurred shortly after treatment.

No hemorrhagic complications were observed, but there were five cases of embolism during the fibrinolytic treatment. Fibrinolytic treatment would seem to be an attractive, nonsurgical alternative for the thrombosis of a valve prosthesis but, because of the risk of embolism with possible permanent damage, its use should be reserved for critically ill patients who are too sick to undergo immediate surgery.

(J Am Coll Cardiol 1986;7:743–51)

Despite improvements in the design of prosthetic cardiac valves, arterial thromboembolic complications after valve replacement remain a frequent cause of illness and mortality, often as a result of defects in anticoagulant therapy. An even more life-threatening event is massive thrombosis of the valve itself, which must be detected and treated promptly. Echocardiographic and cineradiographic studies of tilting disc valves are often helpful for early diagnosis. The reported incidence of thrombosis ranges from 0.5 to 5% (1–4), with a mortality rate of about 40% before or in spite of surgical treatment. Thrombectomy and debridement of the disc valve are the treatments usually favored in such cases, especially for aortic valves (5,6). However, many catastrophically ill patients die suddenly before an operation can be carried out. We tried fibrinolytic treatment in such patients and, after its initial success, extended its use. This report describes our findings in 26 patients who presented with 28 instances of thrombotic obstruction of a tilting disc or bileaflet valve.

Methods

Patients in the study (Table 1). Between June 1979 and June 1984 more than 1,000 prosthetic cardiac valves were implanted at our hospital. A great number of the patients receiving these valves could not be retraced or died in unknown circumstances. In addition, three patients with prosthetic thrombosis, in whom fibrinolytic therapy was contraindicated, were treated surgically and are therefore not included in this report. During this period, we documented 28 massive acute thromboses, which cannot be representative of all the complications that occurred. The 28 prosthetic valve obstructions occurred in 26 patients, 17 women and 9 men aged 17 to 81 years (mean 55.6), and involved 15 mitral prostheses (1 with recurring thrombosis

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Manuscript received April 8, 1985; revised manuscript received October 29, 1985, accepted November 13, 1985

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0735-1097/86/$3 50

Table 1. Summary of 28 Cases of Prosthetic Valve Thrombosis in 26 Patients*

Case	Age (yr) & Sex	Delay (mo)	Valve Prosthesis	Clinical Presentation	Findings on Auscultation	Echo	Cineradio.	Treatment	Evolution
1	55F	4	SJM Mit	APE, shock	Abs. clicks, MR 4/6			UK	Failure, surgery, died
2	48M	3	SJM Ao	Sub. APE, cardiac arrest	Abs. clicks, AS 4/6			UK	Success
3	48M	3 + 19	SJM Ao.	Sub. APE, 2 cereb. embol.	AI 4/6, MR 3/6, clicks +	+	Cineangiogram	SK	Success, surgery 6 months later
4	42M	6	SJM Ao.	Leg embol.	AI 3/6, muted clicks		Cineangiogram	UK	Success
5	60M	2	BS Mit.	APE, shock, VF	Abs. clicks	+	+	UK	Success, embol.
6	60F	14	BS Mit.	Sub. APE, leg embol.	Abs. clicks, MR 3/6	+	+	UK, SK	Success, embol
7	60F	14 + 4	BS Mit.	APE, leg embol.	Abs. clicks, MR 3/6	+	+	SK	Success, surgery
8	72F	36	SJM Ao	APE, BP 80/40	Abs. clicks	±		SK, UK	Success
9	55F	7	KO Mit.	APE, leg embol.	Click + MR 3/6	+	Right cath.	SK, UK	Success
10	52F	15	BS Ao.	APE, shock	Abs. clicks, AI 3/6, AS 3/6	±	+	SK, UK	Success, surgery
11	69F	8	KO Mit	APE, shock	Abs. clicks, MR 3/6	+		SK	Success, embol
12	81M	9	KO Ao.	Cereb. embol.	Muted clicks, AI 2/6	0	+	UK	Success
13	55F	18	BS Mit.	APE, low output syndrome	Muted clicks	—	+	SK	Improvement, died 10th day
14	71M	32	BS Ao.	Sub. APE, shock	Abs. clicks, AI 2/6, AS 4/6	+	+	SK	Success
15	65F	33	BS Ao.	Sub. APE, shock, anginal pain	Abs. clicks, AI 4/6, AS 4/6	+	+	SK	Success
16	76F	36	BS Mit.	Sub. APE	Abs. clicks, MR 3/6	+		SK	Success
17	55F	4	KO Mit.	Sub. APE, leg embol.	Clicks + MR 2/6	±	± Right cath.	UK	Improvement, died 7th day
18	43F	22	BS Mit.	APE, shock	Abs. clicks, MR 3/6	+	+	SK, UK	Success, embol
19	66M	96	BS Ao.	APE, anginal pain	Muted clicks, AI 2/6	±		SK	Success
20	55M	21	KO Mit.	APE, AF	Abs. clicks	+		SK	Success
21	48F	132	BS Mit	APE, AF	Abs. clicks	+		UK, SK	Improvement, surgery, died
22	44M	15	BS Mit.	Cereb. embol	Clicks + MR 4/6	+	+	SK	Success
23	64F	84	BS Ao.	APE, low output syndrome	Muted clicks, AI 3/6, AS 3/6	±		SK	Success
24	48F	33	BS Ao.	APE	Abs. clicks, AS 3/6	+	+	SK	Success, embol.
25	40F	60	BS Mit.	APE, shock	Abs. clicks, MR 3/6	+	+	SK, UK	Success
26	64F	48	SJM Ao	Sub. APE, anginal pain	Abs. clicks, AI 2/6, AS 4/6	—	+	SK	Success
27	17F	14	SJM Mit.	APE, cardiac arrest	Abs. clicks	+	+	UK	Failure, surgery
28	42M	40	BS Mit.	APE, VT, shock	Abs. clicks, MR 4/6	+	+	SK	Success

*Cases 2 and 3 involved Patient 2 and Cases 6 and 7 involved Patient 6. Abs = absent; AF = atrial fibrillation; AI = aortic insufficiency murmur; Ao = aortic; APE = acute pulmonary edema; AS = aortic stenosis murmur; BP = blood pressure (mm Hg), BS = Bjork-Shiley, Cereb. = cerebral; Cineradio. = cineradiography (+ = immobile or scarcely moving disc; ± = diminished opening angle); Echo = echocardiogram (+ = diagnostic of thrombosis; ± = doubtful; — = nondiagnostic; 0 = uninterpretable); embol. = embolism; F = female; KO = Kaster-Omniscience valve; M = male, Mit. = mitral; MR = mitral regurgitation murmur; Right cath = right heart catheterization; SJM = St. Jude Medical valve; SK = streptokinase; UK = urokinase; VF = ventricular fibrillation; VT = ventricular tachycardia.

4 months later) and 11 aortic prostheses (1 with recurring thrombosis 19 months later). The valve types were as follows: 15 Björk-Shiley disc prostheses (9 mitral, 6 aortic), 5 Kaster-Omniscience disc prostheses (4 mitral, 1 aortic) and 6 bileaflet St. Jude Medical prostheses (2 mitral, 4 aortic). Excluding ball valve prostheses, the tilting disc and bileaflet valves are the only ones used by our team of surgeons. All 26 patients showed distinct improvement in their condition after valve replacement; postoperatively 14 were in New York Heart Association functional class I and 12 were in class II. Thrombosis occurred between 2 months and 11 years after valve insertion: in 14 cases within 18 months, in 8 cases between 18 and 36 months, and in 6 cases after 3 years. At the time of valve thrombosis, in 18 cases the patient was receiving no anticoagulant therapy or had an inadequate anticoagulant level; in the remaining 11 cases the patient had effective warfarin therapy with optimal prothrombin times.

Clinical features. The main clinical signs at the time of acute thrombosis of the prosthesis are summarized in Table 1. In 15 cases the patient had acute pulmonary edema, low cardiac output and hypotension; cardiac arrest occurred in 2 and ventricular fibrillation and tachycardia occurred in 2 others. In 10 cases the patient had subacute clinical deterioration, 5 presenting with congestive heart failure and peripheral or cerebral embolism and 3 presenting with subacute pulmonary edema and severe dyspnea. In the three remaining cases the symptoms were systemic embolic episodes. The auscultatory findings were abnormal in all 28 cases: absent prosthetic clicks with loud systolic or diastolic murmurs in 19, muted or intermittent closing clicks with the appearance of unusually loud murmurs in 5 and only prominent systolic murmurs in 4. Chest roentgenograms showed evidence of pulmonary edema in 25 cases with enlargement of heart size in 16.

Diagnostic procedures. Complementary investigations (Table 2) confirmed the clinical indications of thrombosis of a prosthetic valve in all but the first two patients, who were in serious clinical condition. M-mode and two-dimensional echocardiograms were obtained with a Varian 3000 or an RT 400 ultrasonoscope equipped with a 2.25 MHz transducer. The patients were examined in the supine position. The echocardiographic examination was performed in accordance with previously described standard techniques (7–9). In each patient various transducer angulations were attempted to obtain the maximal disc excursion. In 16 patients the tilting disc or the leaflets were radiopaque and allowed direct visualization of the disc motion by cineradiography. Following the technique described by Björk et al. (10), the prosthesis was examined in two beam directions: a beam direction corresponding to the axis of motion of the disc was found to calculate the maximal opening angle; a beam direction deviating 30 to 40° from the valve ring plane was used to study prosthetic valve closure. In four patients the diagnosis was not clearly confirmed by the preceding investigations and cardiac catheterization and angiocardiography were performed.

Table 2. Diagnostic Procedures

Examination	No. of Cases
Echocardiography	7
Echocardiography, cineradiography	12
Cineradiography	3
Angiography	4
No examination	2

Treatment. In all 28 cases of prosthetic thrombosis the patient was initially treated by fibrinolysis. The fibrinolytic agent was streptokinase (Streptase, Hoechst Laboratories, Germany) or urokinase (Urokinase, Choay Laboratories, France). In 14 cases streptokinase was infused in a peripheral vein with an infusion pump for 10 hours and 20 minutes (loading dose of 500,000 U in 20 minutes followed by 1,500,000 U for 10 hours). In seven cases urokinase was infused under the same conditions for 12 hours at a constant dose (4,500 U/kg per h) without a loading dose. In seven cases, the first fibrinolytic agent used (streptokinase in five cases and urokinase in two) was insufficient and the other fibrinolytic agent was infused at the same dose 24 or 48 hours later. In all cases the choice of treatment was arbitrary. Urokinase and streptokinase were administered in the doses usually recommended in cases of pulmonary embolism (11).

Heparin infusion was introduced after the fibrinolytic treatment, when the fibrinogen level was higher than 0.5 g/liter; this was usually 6 to 18 hours after the end of the fibrinolytic treatment. Heparin infusion to obtain a thrombin time at least twice the control value was continued for 7 to 10 days, then replaced by warfarin treatment adjusted to obtain optimal prothrombin times.

Blood coagulation tests were performed before fibrinolytic treatment, at the end of treatment, 6 and 12 hours later and then daily. They included measurement of prothrombin time, cephalin-kaolin time, determination of fibrinogen by the chronomatic method of Van Clauss (12), detection of fibrin/fibrinogen degradation products by means of latex particles coated with a new antibody (13) and determination of plasminogen level by chronometric method on chromogenic substrate (14).

Evaluation of the results of treatment was based on clinical and auscultatory findings and echocardiographic and cineradiographic studies. When necessary, right or left heart catheterization, or both, and cinecardiography were performed after treatment.

Results

Clinical results (Table 3). In 28 instances of acute thrombosis of a prosthetic heart valve in 26 patients, fibrinolytic therapy was administered. The treatment was im-

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Table 3. Clinical Results of Fibrinolytic Therapy in 28 Instances of Prosthetic Valve Thrombosis in 26 Patients

Results of Fibrinolytic Therapy		Subsequent Treatment	Patient Outcome
Success	23	Medical treatment : 18	Alive 18 (69.2%)
		Surgical revision : 3	Alive 3 (11.5%)
Improvement	3	Medical treatment : 2	Died 2 (11.5%)
		Surgery : 1	Died 1
Failure	2	Surgery : 2	Alive 1 (7.7%)
			Died 1

mediately (<24 hours) and entirely successful in 23 instances of thrombosis in 21 patients (thrombosis recurred in 2 patients who were again successfully treated by fibrinolysis). In these 21 patients, congestive heart failure, shock and arrhythmias disappeared. The prosthetic closing clicks reappeared suddenly and loud murmurs subsided. After a follow-up period of 6 to 64 months (mean 36.5 ± 16), 18 of the 21 are well and in functional class I or II, free of new embolic episodes with anticoagulant therapy. Three patients were later reoperated on: two for persisting echocardiographic or cineradiographic abnormalities (residual thrombus was found on the prosthetic ring during surgery: thrombectomy in one patient and replacement with a xenograft valve in one); the third patient underwent surgery after two successfully treated thromboses (the operation showed that the valve was, in fact, quite normal and free and it was left in place).

In three patients, there was incomplete clinical improvement: congestive heart failure disappeared slowly, but closing clicks reappeared. Surgery was under consideration for two of these patients when they died suddenly from a new massive thrombosis on the 7th and 10th day, respectively, after treatment. The third patient was reoperated on 3 days after fibrinolysis, but died soon afterward from intractable hypotension despite insertion of a xenograft valve. Fibrinolytic treatment failed completely in two patients who suffered from persistent cardiogenic shock and pulmonary edema, leading to surgery 1 day after fibrinolysis. In these two patients a St. Jude Medical valve was replaced by a xenograft valve; one of these patients survived, the other died.

Complications of fibrinolytic treatment. We did not observe any hemorrhagic complications; there was no bleeding or neurologic hematoma even in the patients with transient neurologic signs of cerebral embolism in the days preceding fibrinolytic treatment. In contrast, arterial thromboembolic complications occurred during treatment in five cases (cerebral embolism in two and peripheral embolism in the left arm and the legs in three). All symptoms were

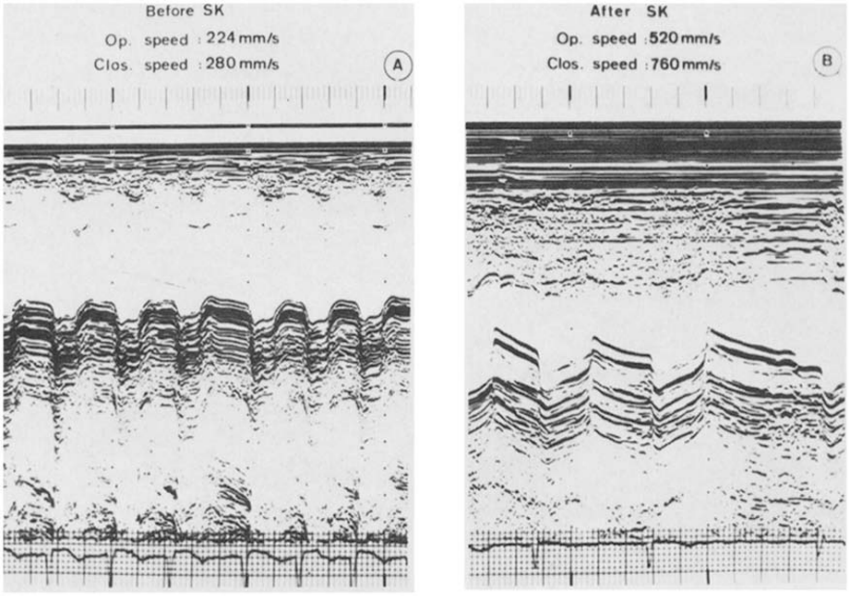


Figure 1. M-mode echocardiogram of a thrombosed Björk-Shiley prosthetic valve in the mitral position. **A**, Before streptokinase (SK) therapy. There are dense echoes at the site of the prosthesis, with rounded angles; the disc is not quite clear, with diminished opening (Op.) and closing (Clos.) rates. After fibrinolysis (**B**), the echocardiographic pattern is quite normal, with normal opening and closing rates.

transient and subsided a few hours to 2 days later with medical treatment except in one patient with leg embolism who was surgically treated. We think that these emboli were linked to the breaking up of the clot situated near the prosthetic heart valve.

Hemodynamic results. Right heart catheterization was performed with a Swan-Ganz catheter in five patients, four with prosthetic mitral thrombosis and one patient with prosthetic aortic thrombosis. In four patients, we observed good improvement: pulmonary artery systolic pressure decreased from 62.7 ± 19 to 39.5 ± 13 mm Hg ($p < 0.02$), pulmonary artery diastolic pressure fell from 29.1 ± 11 to 15.2 ± 4 mm Hg ($p < 0.01$) and cardiac index rose from 0.8 ± 0.4 to 0.95 ± 0.2 liters/min per m^2 ($p < 0.01$). In the fifth patient, pulmonary pressures diminished slightly and the cardiac index stabilized at 1.4 liters/min per m^2; emergency operation was performed.

Echocardiographic results. An echocardiogram was performed in 15 patients with a mitral prosthetic valve. In 13, the patterns suggested thrombosis of the valve (Fig. 1) with diminished amplitude of excursion, marked reduction of both the opening (24 to 184 mm/s) and closing (90 to 380 mm/s) rate of the disc and blunting of upstroke and downstroke. In two, the echocardiographic features were doubtful or did not suggest a thrombotic obstruction. After fibrinolytic treatment, all abnormal features disappeared in 11 of the 15 patients: opening rate increased from 144 ± 188 to 487 ± 175 mm/s ($p < 0.001$) and closing rate increased from 224 ± 105 to 753 ± 293 mm/s ($p < 0.001$) (Fig. 2), disc excursion became normal and upstroke and downstroke were sharp. Eight thrombi around the prosthetic valve in the left atrium, evident on two-dimensional views, totally disappeared after treatment. In four patients abnormal valve features persisted with diminished opening and closing rates or intermittent reduction of disc excursion or blunt angles. One of these patients was operated on with success and the three others died a few days later without or despite surgery.

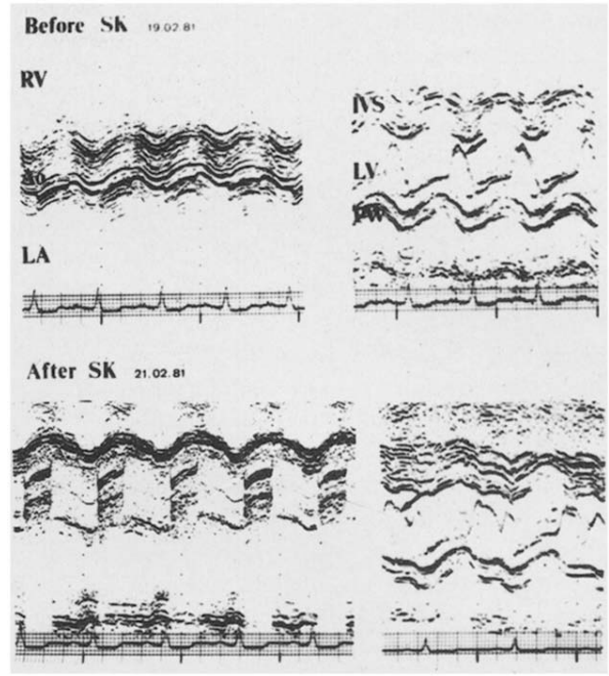
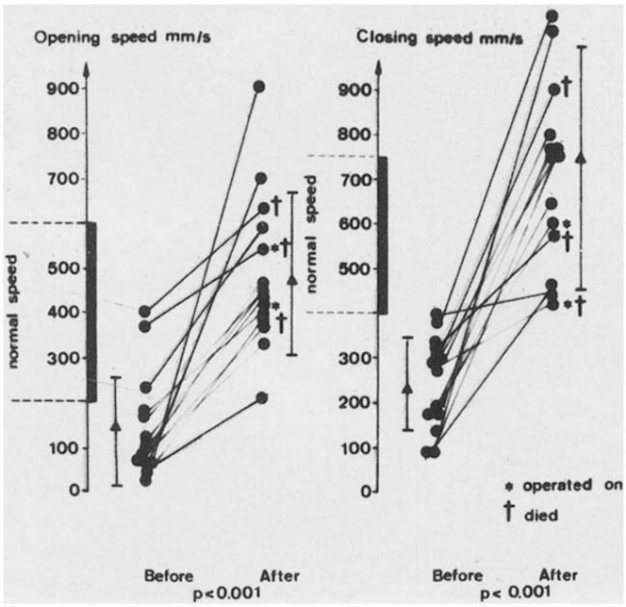


Figure 3. M-mode echocardiogram of a thrombosed Björk-Shiley prosthesis in the aortic position. Before streptokinase (SK) treatment (**top**), the aortic (Ao) root echocardiogram (**left**) is filled with dense, thick echoes; no disc is visible. There is fine fluttering of the anterior leaflet of the mitral valve (**right**). After fibrinolysis (**bottom**), all signs of dysfunction disappeared; there is no mitral fluttering. IVS = interventricular septum; LA = left atrium; LV = left ventricle; PW = posterior wall; RV = right ventricle.

Figure 2. Evolution of opening and closing rates, before and after fibrinolysis, of the disc valve prostheses in the mitral position in 14 cases. The patients who died from recurrent thrombosis or after surgery had apparently normal opening and closing rates. One patient with a St. Jude Medical valve in the mitral position is not presented in the figure.



An echocardiogram was performed in 10 patients with an aortic prosthetic valve. In only four patients was echocardiographic evidence of thrombosis obtained that included absence of disc motion, filling of the aortic root with dense, thick echoes and fluttering of the mitral valve (Fig. 3). In four patients the echocardiographic pattern was doubtful and could not be used to determine the diagnosis even on two-dimensional views. Two echocardiograms allowed no diagnosis of thrombosis (one St. Jude Medical valve seemed normal and there was one unsatisfactory recording). Fibrinolytic treatment normalized the eight abnormal or doubtful echocardiographic patterns; after treatment, the recording showed a clearly moving disc in the aortic lumen and a normal mitral valve.

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Cineradiographic studies. In 16 patients the tilting disc or the leaflets were radiopaque. The diagnosis of thrombosis was simply and instantaneously confirmed in 11 patients in whom the disc was immobile, fixed in an intermediate position (Fig. 4) or had an angle of motion less than 15°. In three patients the opening angle was 20 or 30°, in one patient the opening angle was 50° but closure was incomplete and in one patient the opening angle was 40°. After treatment the opening angle became normal (>45°) in 13 patients (Fig. 5). In one patient the opening angle remained unchanged at 40° and death occurred 7 days later.

Angiocardiographic studies. Aortography was performed in two patients with a nonradiopaque St. Jude Medical valve in the aortic position. The cineangiograms showed severe aortic insufficiency and one leaflet remained fixed but these findings disappeared after fibrinolytic treatment. In two patients with a mitral Kaster-Omniscience nonradiopaque disc valve, cineangiograms revealed a marked delay of left atrial emptying, filling defects around the prosthesis and an immobile disc. Reexamination after treatment confirmed normal disc motion and absence of thrombus in one of these patients.

Fibrinolytic findings. In seven cases the patient received urokinase and streptokinase treatment successively. Therefore, 35 fibrinolytic treatments were administered (14 urokinase and 21 streptokinase). The fibrinogen levels decreased with both streptokinase ($-78 \pm 2\%$) and urokinase ($-33 \pm 18\%$) ($p < 0.01$). The plasminogen levels decreased with streptokinase from 90.4 ± 11 to $8.8 \pm 6\%$ and with urokinase from 88.8 ± 9 to $44.3 \pm 21\%$ ($p < 0.001$). The mean level of fibrin/fibrinogen degradation products was 61.8 ± 26 μg/ml after urokinase and 345.5 ± 410 μg/ml after streptokinase ($p < 0.05$). However, there was no correlation between the clinical course and the biologic results. In five cases of treatment failure or incomplete improvement, fibrinogen level decreased below 0.80 g/liter in three and was unchanged in two. On the other hand, among the 23 clinical successes, the fibrinogen and plasminogen levels remained unchanged, or fibrinogen was higher than 1.50 g/liter in 8 cases. Finally, we observed no difference between urokinase and streptokinase treatment: there were 14 urokinase treatments with 8 successes (64%) and 21 streptokinase treatments with 14 successes (66%).

Discussion

Thromboembolic complications are a permanent risk with prosthetic cardiac valves, despite anticoagulant therapy and improvements in valve design. The most severe form is thrombosis of the prosthesis itself. The incidence of late

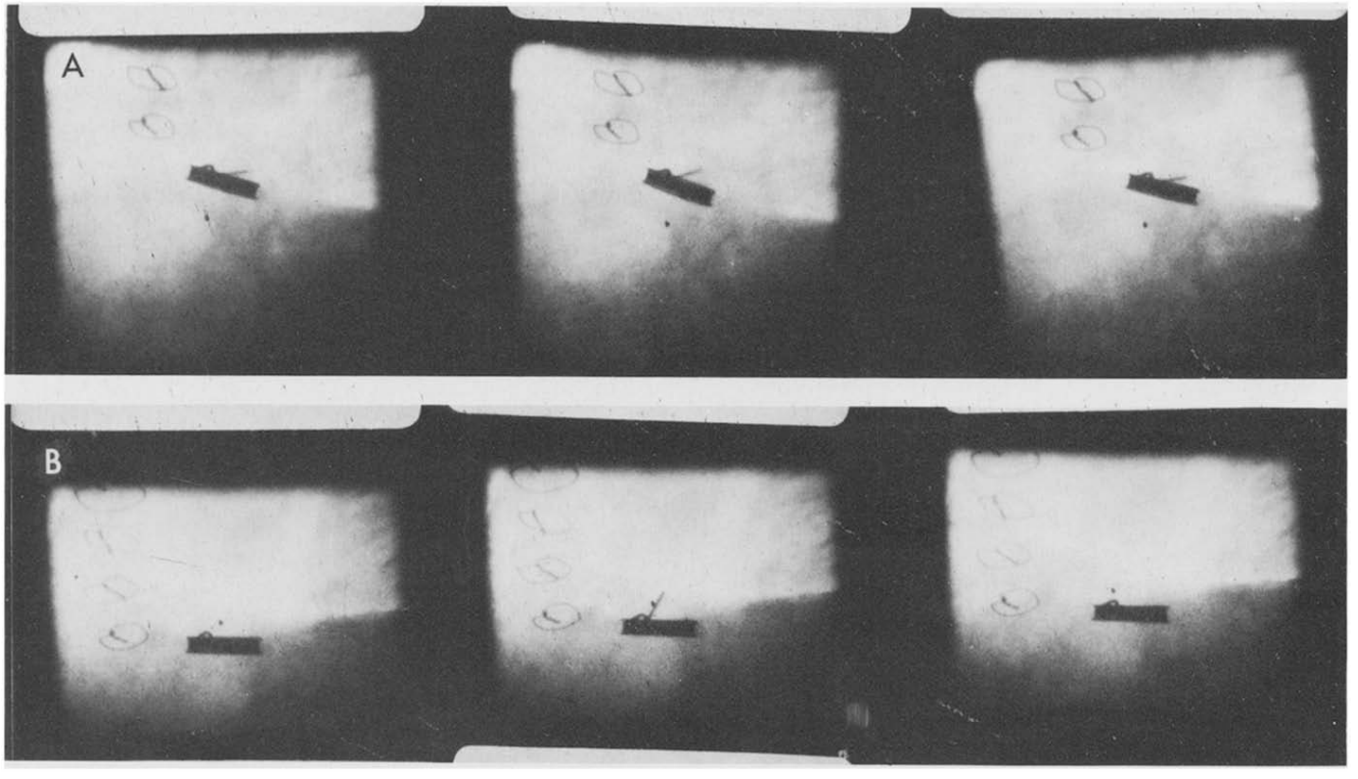

Figure 4. Cineradiographic examination, at a rate of 25 exposures/s, of a tilting disc Björk-Shiley prosthesis in the mitral position. The beam direction corresponds to the axis of motion of the tilting disc. **A**, On admission, the radiopaque marker is immobile in the intermediate position. **B**, After fibrinolytic treatment, the maximal opening angle is 60°.

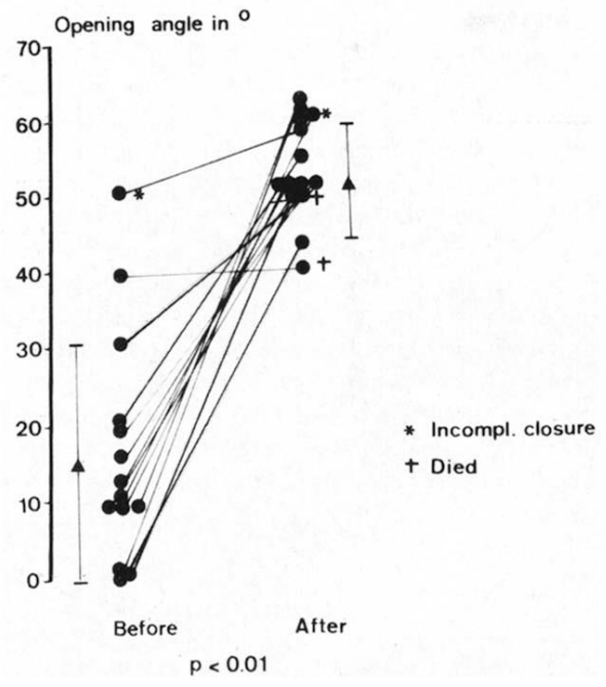

Figure 5. Evolution of opening angle of radiopaque tilting disc valves before and after fibrinolysis in 14 cases. One patient had the same angles and died. The patient with incomplete (Incompl.) closure was operated on. The two with a radiopaque bileaflet St. Jude Medical valve are not presented.

arterial thromboembolic complications appears to be the same with disc valve and ball valve prostheses (1). Only disc valves were involved in our study, which are the only type of valve inserted by our surgeons for hemodynamic reasons and because of their slight degree of hemolysis.

Predisposing factors. Many factors other than valve design affect thromboembolic complications. Long-term anticoagulant therapy is the most important (15–17). In our study 17 patients had no effective anticoagulant treatment. Anticoagulant therapy was not used in 4 of the 17 patients after St. Jude Medical valve insertion because of our initial policy, in 6 patients it was discontinued for medical reasons or by the patients themselves and in 7 patients receiving warfarin derivative treatment, control of prothrombin time was inefficient. Eleven patients had effective anticoagulant treatment at the time of thrombotic obstruction, but seven of them had had repeated normal or suboptimal prothrombin time at routine follow-up visits during the preceding months.

Atrial fibrillation (13 cases in our study) also increases the risk of thrombosis. Enlargement of the left atrium (two cases in our study) and previous valve infection (two cases) are additional risk factors.

Clinical features. The clinical characteristics of thrombosis of prosthetic valves have been clearly defined by other investigators (3,18,19). In most cases the clinical deterioration is acute and quickly becomes life-threatening. However, in some patients signs of congestive heart failure and chest pain appear progressively a few weeks before the thrombotic dramatic accident. Five patients in our study had intermittent dyspnea or dizziness 2 months before hospital admission. Therefore, minimal symptoms in patients whose condition was good after valve replacement require careful investigation.

Diagnostic considerations. Echocardiographic study appears to be of considerable value in the diagnosis of tilting disc and leaflet valve thrombosis in the mitral position (9,20), where recording is not difficult and can be reproduced. In the case of massive thrombosis, the echocardiographic pattern is quite evident and diagnosis can be determined. With partial thrombosis, diagnosis is more difficult and comparison with a previous baseline echocardiogram is important. Time must be taken to identify intermittent reduction of disc motion or blunt angles and to evaluate reduction in opening and closing rates compared with rates in the postoperative baseline echocardiogram. Echocardiographic study of a prosthetic valve in the aortic position is more difficult and often unusable for diagnosis for technical reasons, despite use of the suprasternal and supraclavicular approach which may provide interesting information. With the St. Jude Medical valve in the aortic position, an echocardiogram may appear normal when only one mobile part of the valve is fixed. Thus, cardiac catheterization should be performed in patients in whom thrombosis is clinically suspected and a nondiagnostic echocardiogram should also be obtained (21). Echocardiograms are also valuable in the assessment of the efficacy of fibrinolytic treatment. After treatment, the echocardiographic pattern of the prosthetic valve should become quite normal, similar to a postoperative one, with normal opening rate, closing rate and disc motion. All persisting abnormal features must lead to angiographic study and surgery.

When the disc or the leaflets of the valve are radiopaque, cineradiography is the first examination to be used for diagnosis. This method is simple and well tolerated by all patients, even when critically ill. The opening angles are not the same for different prosthetic valve types and depend on the transvalvular flow. Marked left ventricular failure may diminish the opening angle. Also, only a very reduced opening angle, far below that of the normal value (60° for Björk-Shiley, 80° for Kaster-Omniscience and 90° for St. Jude Medical valves), associated or not with incomplete closure, confirms the diagnosis of thrombosis. The feature most often observed is a disc fixed in an intermediate position or barely moving around this intermediate position. In our experience, cineradiography affirmed the diagnosis in 15 of 16 examinations. When thrombosis of a prosthetic valve is clinically suspected, cineradiography should be the first examination because of the absence of risk and its rapidity and sensitivity. This study is also valuable in the assessment of fibrinolytic treatment; it can accurately evaluate the extent to which the prosthesis has been cleared after treatment. Persistent reduction of an opening angle requires cardiac catheterization and surgery without delay.

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Among patients in poor clinical condition with abnormal prosthetic sounds, the echocardiogram or cineradiogram, or both, always confirmed the diagnosis of thrombosis in our study. An angiographic examination was necessary in only four patients who were in relatively good condition with minimal symptoms but who were suspected of having prosthetic thrombosis.

Therapeutic considerations. Massive thrombosis of a prosthetic cardiac valve is always a life-threatening event. In three published studies (3,5,16), the mortality rate was between 33 and 60.2% before or after reoperation. Simple thrombectomy on an aortic valve prosthesis seemed to give better results, with five successes in eight cases for Björk and Henze (22) and seven consecutive successes for Ayuso et al. (5). However, nonsurgical treatment is an attractive alternative, especially for very sick patients.

In the first patients to be treated with fibrinolysis for acute thrombotic obstruction of a prosthetic cardiac valve, reported in 1971 and 1977, the tricuspid valve was involved (23,24). In 1980, Witchitz et al. (25) reported on fibrinolytic treatment in 13 consecutive cases of thrombosis at mitral and aortic valves with a 70% success rate. Our study began in 1979 and includes 28 cases (26 patients). Fibrinolysis, without surgery, was entirely successful in 18 of these cases. The patients were followed up for 6 to 64 months without recurring thromboembolic accidents. These findings demonstrate that surgical intervention is not necessary after effective thrombolytic treatment. All of these patients receive permanent adequate anticoagulant therapy. In two other patients, all clinical and echocardiographic signs of valve dysfunction disappeared with fibrinolysis, but thrombosis recurred 4 and 19 months later, respectively, when anticoagulant therapy was ineffective. The recurrence probably represented a new thrombotic obstruction rather than residual thrombus after the first treatment. In one patient, surgical revision after a second fibrinolytic treatment proved unnecessary and the prosthetic valve was left in place. The final success rate was 21 (75%) of 28 cases.

In our study the fibrinolytic treatment took effect quickly (within 12 to 24 hours), with closing valve clicks reappearing suddenly. After that interval, absence of improvement or persistent signs of dysfunction require reoperation, which can be performed a few hours after fibrinolytic activity has been neutralized by protease inhibitors and fresh plasma. Two operations were performed in such circumstances without hemorrhagic complications: one patient survived and the other patient died of left ventricular failure on the third day after the operation.

The choice of either urokinase or streptokinase fibrinolytic treatment was arbitrary and both agents were equally effective. In seven cases, the first treatment was only partially successful and persistent signs of dysfunction required a second treatment with the other drug 2 to 3 days later. It is possible that a longer initial period of treatment with the first drug, over 24 or 36 hours, would give the same results. In the other reported experiments, the dosage of drugs and times of infusion are variable and no conclusions can be reached. With our treatment, no hemorrhagic complications were observed and, in any event, these are not common. The major risk is embolism from thrombolysis of the valve thrombus. This complication is infrequent: 2 instances in the 13 patients of Witchitz et al. (25) and 5 in 28 cases in our study. All the patients recovered with medication (fibrinolysis) or surgical treatment (femoral embolism extraction). Nevertheless, because small emboli could easily result in permanent brain damage such as hemiplegia we do not recommend the systematic use of fibrinolysis in all cases of thrombosis of prosthetic heart valves, but believe it should be reserved for critically ill patients who are too sick to undergo immediate surgery.

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